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Introductory Lectures

for 1815

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James Rush N.D.

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*Lecture for 1815*

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**RIDGWAY BRANCH.**

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COMMUNITER BONA PROFUNDERE DEORUM EST.

I have come before you to deliver an introduction to the lectures of the late Dr. Benjamin Rush on the Institute and Practice of Medicine, In thus addressing you I do not feel as if I were performing a voluntary task. It is a duty. By the favor of the author of these lectures I have been made the possessor of them, and I should be unworthy of the trust, if I were not by an endeavour to extend the truths they contain, to aim at some slender imitation of the exertion of him who used so much industry to originate and teach them. The present time has been call'd with a sentiment of reproach the age of lectures, In thus adding to the number, I feel disposed to question the advantages that are said to result from them made of instruction and to ask if greater benefits might not be derived from the more deliberate opportunity which books

When a body floats in water it affects a particular position, and this position is such, that the line which joins the centre of gravity of the body and the centre of gravity of the immersed part is always vertical. —

By Bulkinson a thin Man was taken five feet two inches

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afford for receiving knowledge and reflecting  
upon it, than can take place in the hasty trans-  
actions of oral discourse. - The business of pub-  
lic lectures is like the other practices of the world  
into which abuses have crept by the interests of  
men and the oversight of time. Their advantage  
was real and indispensable to the student  
at their institution. They had their origin with  
teachers who had knowledge to communicate  
and who had not the multiplied means of  
the press to extend that knowledge to other  
times and places. Printing has changed the  
mode of many arts and books have now  
become the common and sufficient instructor  
of the world. To this remark there are some  
exceptions. The elements of all knowledge  
must be addressed to the senses, and in  
medical study there are some branches  
so absolutely elementary that an attempt  
to teach them in any other way than by

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exhibiting their objects to the senses. would be<sup>3</sup>  
all in vain. Such branches are Anatomy  
The experiments of Chemistry, The operations  
of Surgery and Materia Medica where it is  
properly or usefully taught by shewing  
and not merely describing the sensible qua-  
lities of Medicines. These subjects will be  
more easily understood and more im-  
pressibly marked by the demonstrations of  
a lecturer. An other occasion on which lec-  
tures may be useful is when they contain  
knowledge or peculiar opinions which can-  
not be obtained from any other source.  
I need scarcely say with what plea I  
claim your attention. The lectures you will  
hear contain not only the record of as  
much experience as has fallen to the lot  
of any teacher, but they contain original  
deductions from this experience and an

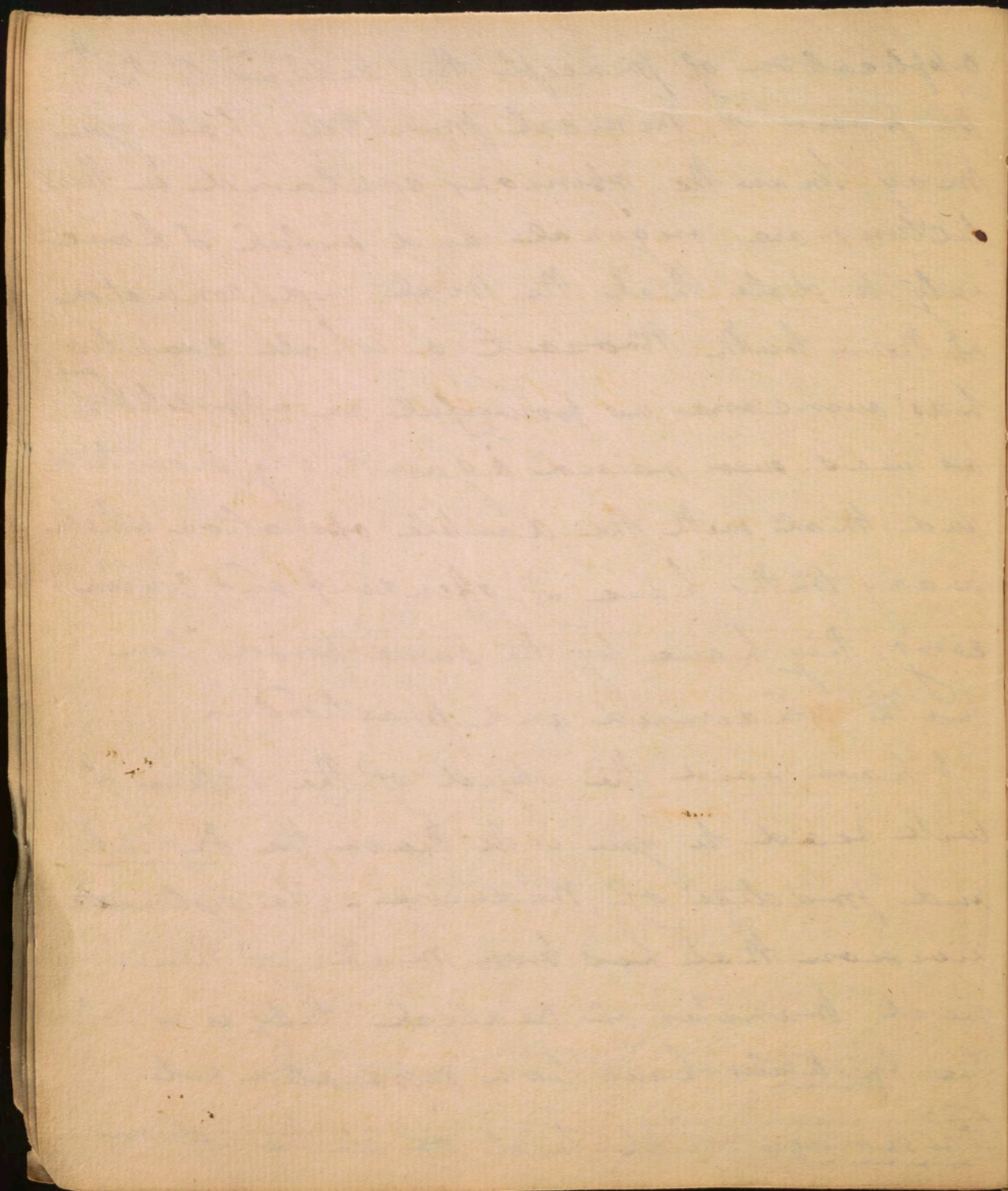
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application of principles thus reduced to the  
purposes of medical practice. That you  
may know the opinions contained in these  
lectures are original and useful, I have  
only to state that the trial and conviction  
of their truth throughout a whole country  
has overcome as powerful an opposition  
as was ever raised against any innovation  
and that with the double operation which  
many truths have of offending and convin-  
cing, they have by the same persons been  
both condemned and practiced.

I have said the object of the lectures I  
will read to you is to teach the Institutes  
and practice of Medicine. The systematic  
division that has been made of these two  
great branches of medical study is as follows  
The Institutes have been separated into  
Physiology which treats of all the actions



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of the body in a healthy state: Hygiene which  
lays down the rules for preserving these healthy  
actions; Pathology which describes the actions  
of the body in a diseased state, and Thera-  
peutics which points out in a general way  
the qualities of medicines for the cure of this  
diseased state. The Practice of Medicine en-  
ters into the detail of all the general rules  
laid down in Pathology and Therapeutics.  
The separation of Institutes and Practice of  
Medicine, is no more than that division  
which every science admits into a specu-  
lative and practical part. - Physiology  
on the first <sup>branch</sup> part of the Institutes, among other  
actions of a healthy body, treats of the form  
and uses of the muscles and points out the  
mode of their operation in the exercises of  
walking running leaping and Swimming  
and I have chosen for this introductory

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lecture to enter into the details of the Physiolo-  
gical action of the exercise of Swimming

Man is almost the only animal that  
cannot swim naturally, and he is almost  
the only animal which by his arts can over-  
come those necessities to which his structure  
seems to limit him. It becomes then a  
subject of philosophical enquiry, why man  
cannot swim naturally and by what ma-  
nagement of his body he can remedy this na-  
tural incapacity. The whole art of swimming  
depends upon the body being of less specific  
gravity than water, and upon the proper po-  
sition and muscular exertion of that body.  
And first of the Boyaney necessary for swimming.  
The human body is in general so much lighter  
than an equal bulk of water that it will  
remain suspended at the surface when unmo-

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sed in it - This difference of gravity will  
appear essential to the art of Swimming, If  
we consider that when animals move in  
fluids lighter than their bodies, there is a two  
fold exertion necessary, one to give them a pro-  
gressive motion thro' it, the other to prevent their  
sinking. Birds move thro' the air which is much  
lighter than their bodies, by means of this two fold  
action of suspension and progression, and the  
great mass of flesh on the breast of these animals  
shows the strong muscular power applied to  
the wings for the laborious exercise of flying.  
But man has proportionally to birds very little  
strength, enough indeed to move him slowly  
thro' the water when he is supported by its greater  
weight, but far short of that vast power which  
would be necessary for his support and pro-  
gress if the water were much lighter than his

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body. If the muscular power of man were <sup>8</sup>  
much increased beyond its present limit then  
the weight of the body might be greater than  
water, for this additional strength would sup-  
port ~~the~~ <sup>it</sup> ~~body~~ in the lighter fluid, and swimming  
would then be effected upon the principles of  
the art of Flying. - In order that man may  
swim then his body should be somewhat lighter  
than an equal bulk of water, that it may  
be supported on the surface, and the experi-  
ence of divers proves that it is so. They cannot  
dive to great depths ~~except they~~ without in-  
creasing their weight by some heavy body, or  
by giving themselves a powerful impetus by  
a fall from a height, or by strong exertion  
in swimming downwards, nor can they remain  
beneath except they ~~seize~~ grasp stones or  
rocks or something permanent to retain  
them. - But this subject of the specific gravity

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of human bodies has been exhibited with 9  
more precise detail by Mr. Robertson in the fifth  
volume of the Phil. Transactions. He employed a  
cistern six feet and a half in length, thirty inches  
wide and thirty inches deep. He noted the weight  
of the man; the height of the water in the cistern he  
gave immersion; <sup>and</sup> the height the water rose to after  
immersion, He then calculated the weight of  
the water which thus rose upon the immersion  
and the bulk of this being exactly equal to  
the bulk of the body, its weight when compared  
with the weight of the body gave the relative  
gravities of the body and water. - From a ta-  
bular view ~~which~~ he has given of all these par-  
ticulars in the cases of ten men whom he sub-  
jected to his experiment, it appears that one  
was one pound heavier than an equal bulk  
of displaced water, and consequently sunk  
Two were of equal gravity with their respec-  
tive bulks of displaced water and therefore -

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would remain immersed at any point in 10  
it, one was fourteen pounds lighter, and would rise  
one was, eighteen pounds lighter -  
one was twenty four.

one -- twenty five

Two -- Thirty and

one -- thirty two pounds lighter than their

respective bulks of displaced water. - It appears  
from these experiments, that the specific gravities  
of men bear no regular proportion to their heights.  
For of two of the subjects, each of whom was  
five feet four inches in height, one was twenty  
and the other thirty pounds lighter than the wa-  
ter. - It appears also that their specific gravities  
bear no regular proportion to their bulk, for of  
two of the subjects, each of whom displaced the  
same quantity of water consequently having the  
same bulk, one was of the same weight as  
the displaced water and the other twenty  
four pounds lighter. - As the specific gravity

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of a man then does not depend upon the 11  
height or bulk of his whole body, the cause of  
the variation must be looked for in the relative  
size of the different parts of it, for these parts have  
different specific gravities. The head is the greatest  
and much superior to water, the gravity of the  
limbs is less than the head but greater than wa-  
ter, the body is about the same as water, and  
the chest is the lightest part, now the chest is so  
much lighter than water as to counterbalance  
the greater gravity of the head and limbs, so  
that the whole body when immersed is lighter  
~~than the water~~. - There is a common notion  
that fat men are lighter in the water than  
those of a spare or slender form. Analogy would  
lead us to believe it, tho' I have met with  
no accurate observations or experiments that  
make it certain. This view of the relative  
gravity of the parts of the body may en-  
able us to judge of the buoyancy of a man

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The first of these is the fact that the  
light in the sky is not uniform. It is  
brighter in some places than in others.  
This is due to the fact that the light  
is not scattered equally in all directions.  
The second fact is that the light is  
not scattered equally in all directions.  
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The tenth fact is that the light is  
not scattered equally in all directions.

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by his form. If the limbs and head be small 12.  
and the chest large on the whole body fat, he  
will float easily near the surface of the water.  
Recollecting that I am still considering merely the  
buoyancy of ~~the body~~ from its greater lightness  
than water without any aid from muscular  
exertion, it is proper to consider in what manner  
its lightness and the difference in the weight of its se-  
veral parts will cause it to float. The centre  
of gravity of the human body is in the middle  
of a line drawn across the hips, and this centre  
which represents the weight of the whole ~~weighs~~  
below the chest or lightest part, therefore when the  
body is immersed in ~~the water~~ the chest will re-  
main above and the hips will descend till the  
body becomes erect and in this posture will  
float, sinking <sup>more or less</sup> beneath the surface according  
to its specific gravity. Thus reasoning to the pre-

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ceasing experiments, the man whose weight<sup>13.</sup>  
was one pound more than an equal bulk  
of water would sink to the bottom. Those who  
were lighter would remain at the surface with  
as much of the body above it as is equal to  
the difference of the weight of the body and the  
water, and this part will always be the upper  
part<sup>ion</sup> of the head. If we suppose the head of a  
man to weigh twenty five pounds, then that  
one who was twenty five pounds lighter than  
the water could float with the whole head  
above the surface. But such a buoy is rarely  
to be met, and the body generally sinks till  
the water rises to about the height of the eyes  
or above them..

I have thus far considered the first essential  
quality for swimming the buoy of the body.  
but this alone would not enable a man to

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continue in the water. - Since the position 14  
he would assume would be as we have just  
seen with his mouth and nose below the sur-  
face and this would prevent respiration on  
which his life depends. In order then that he  
might live in the water by means of his levity  
it would be necessary that he should so far  
incline his head backwards that the portion  
~~which~~ <sup>which</sup> remained above the surface might be  
the nose and mouth, But the face being in this  
case horizontal and the head thrown back to  
nearly a right angle with the body, the posture  
would be too constrained and painful to  
be borne for any length of time, but supposing  
this posture were no inconvenience, yet from  
the slight difference in the gravity of the body  
and water and from the small elevation the  
face would have above the surface, the slightest

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impulse such as the movement of a limb 15  
or the mere stroke of a wave would be sufficient  
to plunge the body so frequently and so far below  
the surface as to disturb the breathing very much  
and finally to destroy it - another cause then  
for the support of man in order that he may live  
in the water, must be sought besides his buoyancy - and  
this cause will be found in the second essential  
for swimming a proper muscular exertion. -

~~This involves so portions as are not in the position~~  
~~top the action of the muscles.~~ This head includes  
the consideration of the proper position for  
swimming since this position is main-  
tained only by muscular exertion. -

The position which offers greatest resistance  
to the ascent of the body in water is the  
horizontal one, and that of least resis-  
tance the upright, for in these opposite cases  
there is the largest and smallest possible sur-

On the back let us suppose -

face directly opposed to the water in its 1<sup>st</sup>  
passage thro it - But we have seen that the  
body when immersed falls to the upright posi-  
tion, the least advantageous for support  
In order therefore to bring it to the proper hori-  
zontal posture <sup>v</sup> the water below must be  
struck by the feet, this elevates the limbs to  
the surface and sets the whole body <sup>in</sup> the  
horizontal line. But the stroke of the feet in  
this situation would not prevent the limbs  
sinking again to the upright direction, the  
horizontal line then must be preserved by  
other means. These are a strong contraction  
of the muscles of the back and hips by  
which these parts are kept in a rigid  
line with the chest. Now the chest being  
the buoyant part of the body and floating  
at the surface, the inferior parts are made  
by this rigidity to project as it were from

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the Chest as a fixed point, and thus the 17.  
horizontal posture is maintained at the sur-  
face. - I wish what I have here remarked  
of the Back and Glips being kept in a  
rigid line with the Chest to be remembered  
since I shall more than once recur to it  
and I hope to show that upon this more  
than upon any other point the art of  
swimming depends. In treating of the hog-  
ancy of the body I said a man could not  
live in the upright position in water, be-  
cause he could <sup>not</sup> keep the head drawn back  
so far that the part which remained above  
the surface might be the nose and mouth.  
But in the horizontal line <sup>in</sup> which he is  
now supposed to be, this difficulty no longer  
exists, and the smallest <sup>in</sup> reflection of the  
head will enable him to breathe with  
perfect freedom. Since then the body ~~is~~

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extended on the back along the surface 18  
has most buoyancy because nearly all the  
body is immersed and as the small portion  
~~that~~ <sup>which</sup> remains <sup>in</sup> above is the face which al-  
lows respiration, It follows that the best  
position for swimming would be for a man  
to throw himself on the back, bring the body  
straight at the surface and by striking with  
the limbs to move thro' the water. - But this  
mode of swimming on the back tho' the  
easiest to be learned if the art were taken  
up synthetically, yet from the slowness of the  
motion in this posture, and the violence <sup>it</sup> ~~does~~  
offers to the habits of man, by his thus moving  
in the opposite direction to which he looks  
and his lying on the back, it is generally  
the last acquired or practiced. - ~~But~~ swim-  
ming is always learned by turning from

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This supine to the prone position, or 19  
with the breast upon the water. Now this  
prone position immediately diminishes the buoy-  
ancy of the body, for ~~as the body~~ <sup>since</sup> when supine  
it was of the same gravity with the water, from  
a small part only being above the surface, and  
as respiration would continue from that part  
being the mouth and nose, when the body is  
turned to the prone position, it becomes heavier  
than water, from the impossibility of breathing  
in this situation without keeping the whole  
head above the surface. hence arises the  
necessity of muscular exertion in swimming  
on the face, to support the body, rendered heavier  
by this elevation of the head,

The phenomena of swimming in this prone  
position are. First the man throws himself  
on the surface of the water, he reflects

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the head from its right line with the 20  
body to nearly a right angle, the legs being  
heavier than water would sink if he did not  
contract the muscles of the back, these by having  
one of their attachments to the chest or lightest  
part and the other to the hips, the latter are  
elevated and held at the surface, and con-  
sequently the legs are kept from sinking to  
their natural situation in the ~~lower~~ water.  
The hands are now slowly stretched out. at  
the same time the joints of the lower limbs  
are slowly bent, then the hands are forc-  
ibly brought round with the palm opposed  
to the water and at the same moment  
the legs are violently extended, The water  
yields to these impulses, but it cannot  
yield as fast as they can be moved, and  
this difference of velocity in the limbs and the

I have been thinking of you very much lately  
 and wondering how you are getting on.  
 I hope you are well and happy.  
 I have been very busy lately  
 but I have managed to find some time  
 to write you a few lines.  
 I have been thinking of you very much lately  
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 I hope you are well and happy.  
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yielding of the water, becomes a solid <sup>21</sup>  
surface for the limbs to press against, and  
the body moves forward with a velocity  
derived from this solid resistance.

I said that in swimming on the face, ~~with~~  
~~the~~ head and neck out of water, the  
body has no buoyancy consequently the  
movement is like flying, in which the body  
besides being ~~supported~~ moved forwards  
must be supported, and indeed the mode  
of action in swimming exactly resembles  
the flight of those birds which move thro'  
the air by a succession of curves. as  
the woodpecker and common yellow  
bird of the country. For the body lying some  
what obliquely at the surface, the legs  
being a little lower than the chest, when

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the water is struck by the feet, the chest 22 is pushed forward and out of the water but being in that raised position, much heavier than before, it is brought back to the water after making a curve on the surface, which curve is forming whilst the hands and legs are preparing for a new stroke, just then as the head is about to plunge beneath in this curve a new stroke is given, and thus by a succession of <sup>leaps</sup> ~~leaps~~ the swimming is continued.

After this art of swimming on the breast has been acquired, an other mode of swimming on the Back is attempted tho' this as I have already said could be much more easily learn'd than the first.

It is done by turning the body on the back

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so that all but the face may be un-23  
der water, the inferior portion of the body  
is ~~then~~ to be retained near the surface by  
the exertion of the back and then by the  
forcible stroke of the feet the movement is ef-  
fected, - The ease with which the body is  
supported in the supine position is manifest  
from the action of the legs alone being suff-  
icient for swimming, whilst the arms may be  
folded or remain at rest, whereas ~~in~~ swim-  
ming on the breast is impracticable without  
the exercise of the hands.

There is another mode of the body in the supine  
situation call'd Floating. In this the body  
rests horizontally at the surface, being suppor-  
ted by a moderate motion of the hands,  
But this support is made at the chest a part

as they make no effort against the water  
for their support,

which from its buoyancy has no need of it. <sup>24</sup>

The inferior heavy portions of the body must be upheld by preserving a stiffness of the back hips and legs, that they may project by an inflexible line from the chest which remains fixed to the surface by its buoyancy and the motions of the hands. - This particular management of the back I have before spoken of as essential to swimming on the breast, But this is the sole cause of floating. -

I have heard that persons have been able to float without using the hands, This a ability if possible is certainly very rare, and must depend upon a structure not often to be met with, If a man has a small head, large chest, slender muscles and limbs ~~and~~ <sup>or</sup> much fat, then perhaps by merely making that muscular rigidity ne

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suffice to keep the body horizontally exten  
and he might be able to float for a short  
times. I say for a short time only for tis impossible  
to continue long that muscular exertion  
by which the body must be kept horizontal.  
There is no such thing in a healthy body as the  
constant action of a muscle without a relaxation  
of it, and the most intolerable pains arise from  
an endeavour to procure a permanency of Mus-  
cular contraction. - The only account of float-  
ing without some exertion of the body, which I have  
met with worthy of reliance is taken from the  
Philosophical transactions, and is as follows. -

" The Lords of the admiralty have appointed for  
the exercise of the scholars belonging to the  
royal academy at Portsmouth a small yacht  
wherein during the summer months these  
young gentlemen are taught the practice

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of working a vessel at sea, under the 26  
direction of one of the master attendants, asis-  
ted by eight or ten seamen. The last time this  
yacht was out one of the scholars was or-  
dered to leave the lead, The youth was about  
thirteen years of ~~age~~<sup>old</sup> small for his age, and  
far from being fat; as he was stepping on  
the gunnel he fell overboard. ~~The yacht had~~  
The sea was rough and the yacht had great  
way so that he was presently at a very con-  
siderable distance from the vessel. The skiff  
was immediately let down, but the painter  
not being fast, the rope run an end and  
the boat went adrift. One of the seamen  
jumped overboard, got into the boat, brought  
her along side of the vessel, took in another  
man and then went after the youth  
whom

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they recovered after ~~they~~<sup>he</sup> had been in the 27  
water more than half an hour. The young  
gentleman relating the affair said, that as  
he ~~could~~<sup>swam</sup> very little and guessing  
he should sink if he strove against the  
waves, he turned on his back and committ-  
ed himself to their mercy. He kept him-  
self perfectly calm, and observed when a wave  
was likely to break over him, to hold his  
breath and to spout out the water forced  
into his mouth."

This case took place in sea water in which  
the buoyancy of the body is greater than in fresh  
as a cubic foot of salt water weighs 73  
pounds whereas a cubic foot of fresh weighs but  
70. ~~pounds~~... I have never heard from any  
authority worthy of credit, of man floating  
in fresh water, and without the peculiar

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structure before mentioned I do not think 28  
it possible.

There is an operation of swimming call'd  
Treading water in which the body is kept  
upright with the head and shoulders, above  
the surface. This is effected by the alternate  
elevation and violent stroke of the feet against  
the water. It is one of the most tiresome ~~not~~  
modes of swimming and can be continued  
but for a short time, owing to the great  
muscular exertion necessary for it. For in this  
case there is a strong tendency of the body to de-  
scend from so much of it being out of the  
water, and the resistance to this descent is  
only made on the small surface of the  
soles of the feet.

There are some other movements in the water  
exhibited as feats of display by dextrous  
swimmers - But these need no particular

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notice as they all depend on the prin 29  
ciples which have been laid down. —

I have thus considered the ~~various~~ phenomena  
of swimming under the two heads of the buoy-  
ancy of the body and Muscular exertion, un-  
der the first I pointed out the relation of the  
gravity of the whole body and its parts to the wa-  
ter, and the position which this caused it to assume.  
Under the last I have shown how the horizontal  
posture is maintained by muscular exertion and  
how the body is propelled by it. I shall now  
take notice of some other particulars of the  
art of swimming, which tho' they are to be  
explained by the previous principles, yet could  
not without a confusing digression be brought  
under the preceding heads. —

It has always been a question, why man  
cannot swim naturally, when it is done by



nearly every brute however young the first 30  
time it goes into the water. - This is common  
ly explained by saying that in man fear pre-  
vents that use of his limbs which would sup-  
port him if he placed a confidence in his  
exertions, whereas brutes swim because they are  
destitute of fear. This view however will not ac-  
count for it, since a little attention will in-  
form us that most brutes are not without this  
apprehension, and some resist with violence any  
attempts to put them in the water. Instead of  
an explanation then it is only an instance of  
that indolent philosophy and acceptance logic  
which the vulgar always employ in their  
inquiring after causes, which fixes on any ma-  
nifest attendant circumstance, as the real  
efficient cause of an effect. But the ques-  
tion is of the easiest solution by attending

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only to the different structure of Man and 31  
brutes. — —

Man is formed to walk erect on a firm  
resting surface with the centre of his gravity  
perpendicular to the base on which he moves,  
If at any time that perpendicularity should be  
lost so as to indicate his falling forward  
there is instantly an endeavour made to pre-  
vent it by drawing the feet forward that the  
line of ~~the~~ gravity may fall within them...  
and this intention and the consequent motion  
is associated by long habit with the last  
perception of a tendency to fall. Now when  
a man goes into the water who cannot swim  
he finds himself sinking or falling. The only  
precautions he has been in the habit of using  
against falling is to bring his feet under the  
centre of gravity at the same time he draws  
out his hands to save the conception of



the body. This mode he at once has he 32  
course to, but it is a vain endeavour for  
safety, as throwing the feet forward under the  
centre of gravity brings him to the upright  
position, and this as we have before seen is  
the least advantageous for support, in the wa-  
ter. - He makes violent exertions with his feet  
once this with the upright position he has now  
assumed, puts him exactly in that state descri-  
bed under the head of Treading water. and  
this we know cannot be continued even by  
the most expert swimmer for any length of  
time. - The consequence is that he is unable  
as in treading water to make <sup>any</sup> progressive  
movement, and becoming soon exhausted  
by his exertions, he sinks beneath the surface  
and is suffocated. - Such being the position  
a man assumes when he goes into the water  
and as this position results from his structure

*[Faint, illegible handwriting on the left page of an open manuscript. The text appears to be a continuous paragraph.]*

*[Faint, illegible handwriting on the right page of an open manuscript. The text appears to be a continuous paragraph.]*

and habits, we may further see how these <sup>33</sup>  
same causes prevent his practicing the proper  
motions for swimming the first time he has  
occasions for them. — For swimming requires  
exercises of the body opposite in every respect  
to the habitual exertions of it. —

Man's usual motion is made in an upright  
posture, in swimming it is horizontal. In  
walking or running on the earth, the legs  
are moved alternately, in the water they  
are moved together constituting a leap. In  
walking the hands are pendulal and alternate  
with no exertion across the body. In swim-  
ming they are moved with great labour  
in a manner opposite to their former di-  
rection, In walking the head is supported  
by the pillar of bone of the back and neck  
and not by muscular power, In swim



ming the head being thrown back to 34  
an angle with the body, and the body be-  
ing ~~horizontal~~, <sup>its</sup> whole weight ~~of the body~~  
is supported by the action of the muscles  
But the great distinction and that on which  
the art of swimming chiefly depends is cer-  
tain contraction of the muscles of the  
back, to retain the hips at the surface  
of the water, which is not necessary for the  
ordinary motions on the earth - Now this  
difference between the management of the body  
in the water and upon the earth, is not  
known by man, and even supposing the  
knowledge of it were communicated by  
instruction, it might much facilitate  
the acquirement of the art of swimming  
tho' without some experimental trials

*[Faint, illegible handwriting on aged paper, likely bleed-through from the reverse side. The text is mirrored across the page.]*

of those different motions he would <sup>35</sup>  
not be able to support himself on  
the water. -

But Brutes we know swim  
without this instruction and experience  
and as we have seen that man is unable  
to swim from his structure and ordinary  
exertions, a little consideration of the  
structure and ordinary exertions of  
brutes, will inform us why they swim with  
so much ease. - Brutes have nearly the  
same specific gravity as man. consequently  
about the same relative portion of the body  
will remain above the water. But it is  
necessary for life that the same part in each  
the head, should be above the surface.  
The head is the heaviest part of man

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whereas the head of butes is compara. 36  
tively lighter. since there is less brain in pro  
portion, the bones of the head are more  
spongy and there is a greater cavity  
within the jaws and in the nostrils. Butes  
then have an advantage over man in the  
lightness of the parts of the body, but they  
have besides other advantages, for the neck  
and head being longer they more easily  
stretch the latter to the surface of the water  
for respiration. The usual position of the  
neck and head being horizontal, ~~the~~ and  
not supported by the back bone as in man  
they are furnished with a strength of mus  
cle to support it without fatigue, therefore  
that elevation of the head which is  
mans greatest inconvenience, is not  
felt by butes. — The centre of gra



uity of brutes is about the lowest part 3<sup>rd</sup>  
of the chest, so that when thrown into the wa-  
ter they naturally take a position with the  
legs pendant and the head upright  
nearly the same as their position on the earth.  
On the second point then or in position the  
brute has the advantage over man, for since  
this is the same in his body that he has been  
used to, it is only necessary to make a  
slight elevation of the head and neck to  
be in the true posture for progressive swim-  
ming. - But man must make a painful  
elevation of the head and a rigid con-  
traction of the back and hips. As regards  
the third point or the muscular exertion for  
the swimming of brutes the advantage is  
more considerable, we have seen how ma-  
ny difficulties man has to encounter.

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*[Faint, illegible handwriting on the right page of the manuscript. The text continues from the left page, with some words like 'the part', 'the', 'which', 'will', 'the', 'only', 'surface', 'city of', 'his', 'home', 'common', 'the', 'at', 'the', 'water', 'the', 'ma' being partially legible.]*

in this part of the function. But in 38  
brats, the motions are all the same that  
he is habituated to on earth, he has only  
to walk thro' the water to move forward.  
Thus whilst men have so many things to  
learn different from their usual habits, brats  
have only to learn to stretch the head to  
the surface of the water, and thus the ne-  
cessity of breathing teaches them the moment  
they fall into it.

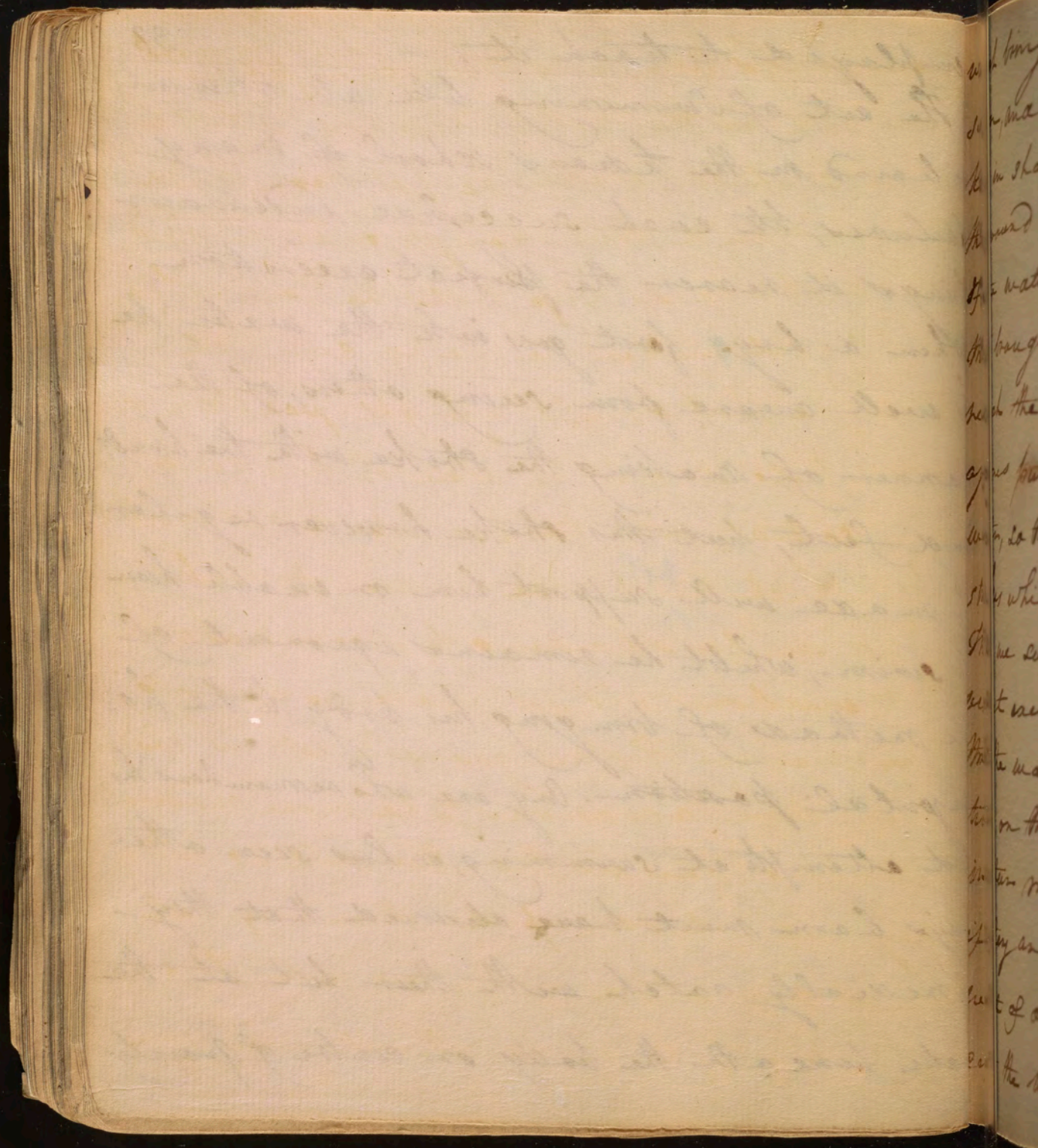
I have said that a knowledge of the theory  
of swimming or the means by which it is  
effected would facilitate the acquirement  
of the art, but ~~it~~<sup>this</sup> alone would not be suf-  
ficient without the experience of trials in  
the water. This suggests to us the consideration  
of the mode in which the art is acqui-  
red and the means that are occasionally

*[Faint, illegible handwriting visible through the paper from the reverse side.]*

employed to teach it. ~

39.

The art of Swimming like all other arts is learned in the tedious school of many failures, till each successive endeavour brings it nearer the perfect execution, When a boy's feet go into the water, he is well aware from seeing others, of the manner of making the stroke with the hands and feet, but this stroke however regularly made will <sup>not</sup> support him or enable him to swim, whilst he remains ignorant of the method of bringing his body to the horizontal position. Any one who remembers his first attempts at swimming, or has seen other boys learn must have observed that they immediately catch with their feet at the water beneath the body or centre of gravity



which brings them to the upright po:- 40-  
sition, and as the art is always undertaken in shallow water, the feet soon touch the ground and the attempt is at an end. If the water be so deep that the feet when thus brought under the body cannot reach the bottom, the upright position it assumes puts it into the state of treading water, so that after the few rapid and violent strokes which this posture requires, it sinks. Thus we see boys learning to swim make very violent exertions and yet make no progress And the water. - They are generally told as instruction on these occasions to be more moderate in their motions, and that they will do better if they are not so rapid. There is great want of observation in this remark, for except the body be in a different position

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from that bay, always assume when 41.  
They first attempt to swim, no other than  
this violent exertion will support them,  
Before therefore they are told to be up impe-  
tuous, they should be directed to raise the  
hips to the horizontal line, for then alone  
when the broad part of the body is pressing  
on the water with a moderate action  
of the arms and legs suffice. For with  
the back convex and the feet dependant  
or with an approximation to the posture  
of treading water, the motion must be  
violent, as the best swimmers exhibit, in  
the forcible impulses they are obliged to make  
on the water to support themselves for a short  
time in this upright position.

After the boy has made many un-  
successful attempts to support himself by this

*[Faint, illegible handwriting on the left page of an open manuscript. The text appears to be a continuous paragraph, possibly in a historical or philosophical context.]*

*[Faint, illegible handwriting on the right page of the manuscript, continuing from the left page.]*

violent exercise of his limbs, he finds 42  
by accident or design, that the more he  
elevates the hips to the surface by straightening  
the back, the more easy the support becomes  
and the more progress he is able to make thro  
the water, till at last he attains a complete  
dominion over that muscular management  
which elevates the body to the horizontal pos-  
ture, and then and not till then he becomes  
a Swimmer.—

Bags in learning sometimes make use of light  
substances as bladders, corks and pieces of wood.  
The bladders and corks are usually placed  
about the chest and by their buoyancy prevent  
the body from sinking even in the upright  
position. But these are generally slow aids  
as they do not teach the essential art of  
elevating the back. The use of a long  
piece.



of wood is better. For the boy laying 43.  
his breast upon it whilst it extends his  
whole length, the lightness of the wood ele-  
vates the body, hips and legs to the horizon-  
tal position, and teaches him to retain  
the same situation when the wood is re-  
moved. The teachers of the art generally  
take boys into the water, and support them  
with the hand under the body, they then  
tell them to strike the hands and feet  
regularly. The great aim of this mode  
seems to be to teach the art of row-  
ing the regular stroke. But the advan-  
tage of the mode really consists in  
the elevation of the back, so that after  
a boy has been held in that position  
for some time by his master, he associates

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the horizontal posture with his attempts<sup>44</sup>  
to swim, and when the hand is removed  
he endeavors to ~~preserve~~ it by the mus-  
cular contraction of the back. Thus  
the hand under the body and the piece  
of wood are not of service from the buoyan-  
cy they give, but because they direct to  
the proper and indispensable posture. Nor  
are these aids of much consequence in  
teaching the stroke, as the support of the  
body does not much depend on its regu-  
larity. Regularity of stroke is absolutely  
necessary to rapid progressive motion.  
But it betrays want of observation, to say  
that a regular and synchronous action  
of the limbs is a necessary preface to the  
art of swimming, since we see in good

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Swimmers who are masters of the 45  
great essential for the art, the flat po-  
sition, can support themselves with the  
most irregular motion of the limbs. And  
those postures they go through for the dis-  
play of feats of dexterity, are made by  
a wide departure from that parallelism  
and regularity of stroke, which are sup-  
posed so necessary for the acquirement  
of the art.

The arts of swimming on the back and  
floating are acquired also by learning  
to bring the body horizontally to the sur-  
face. If we observe a boy attempting  
to swim on the back or float, we  
see he is not master of this art of pro-  
jecting the body along the surface, for

*[Faint, illegible handwriting on the left page of an open book.]*

*[Faint, illegible handwriting on the right page of an open book.]*

tho he pushes the feet above ~~the~~<sup>it</sup> ~~the~~ ~~sur.~~ 40  
~~feet~~, the hips remain sunk and the  
body curved, and as in this curved  
posture he has less extent to oppose to  
his ascent in the water, he can man-  
tain that floating posture but for a  
very short time.

From the principles which have been  
laid down we may easily point out  
by what means swimming may be most  
rapidly made and longest borne without  
fatigue. - The first requisite for rapid swim-  
ming is Buoyancy, for when the body is  
easily supported, less muscular exertion is  
required for that purpose and more can  
be given for its progressive movement.  
The requisite in structure is a broad palm

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and sole, and great muscular power 47.  
for the for the forcible exercise of these. -  
The means in position is that in which there  
is least resistance which is when the body is  
thrown on one side in its progress, for the  
difference of resistance will be then just e-  
qual to the difference of breadth and depth  
of the Chest. - and I am told that the In-  
dians of our country who are expert  
swimmers, use the side method habitually.  
The power of swimming a long time, de-  
pends upon the same principles as the long  
continuance of any other muscular exertion.  
The strength of muscles and the habit of  
using them. Some men from habit are  
able to perform great exertions in this  
way.

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D<sup>r</sup>. Franklin when a youth drew con 48  
severable notice in London from an ex-  
hibit in swimming from Chelsea to Black  
friars bridge, a distance ~~as much as~~ ~~the~~  
~~distance~~ of about three miles. and Baron  
Humboldt relates that there are men  
in Peru who perform the duty of the  
letter post by swimming down their  
rivers for a journey of two days, resting  
occasionally in their course. They use a  
small log as an aid in their support, and  
carry the letters bound in a turban about  
their heads. - Cap<sup>n</sup>. King during his stay  
at the Sandwich islands saw a child of  
only four years of age, that had been  
accidentally over-set in the sea, swim about  
with the greatest dexterity till it regained  
the boat.

For the month  
in May & June  
was in the  
city of Washington  
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and spent much  
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From the motions necessary in swimming<sup>g</sup>,  
we see why that exercise is so tiresome. The  
usual movement of man on the earth is  
walking. and in this we see one of the abun-  
dant instances of the wise economy of na-  
ture in providing for the most necessary and  
frequent wants of animals. For so small  
is the exertion of walking that it is much  
less fatiguing than standing equally on  
both feet for the same length of time. In  
walking, <sup>most of</sup> the weight of the body is borne by  
the pillar of bone of the limb, and very little  
by muscular exertion. The only action of the  
muscles being the tilting the centre of gravity  
alternately on the advanced legs. But  
the action of the limbs in the water is a  
succession of leaps, in which the whole

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weight of the body is propelled by the 50  
muscles. whereas such is the contrivance of  
the art of walking that not a fourth part  
of that weight is moved or supported by  
them, the remainder being upheld by the  
pillar of bone. — The exertion of the hands  
too which are employed in removing the weight  
at a great distance from the centre of  
motion at the shoulders, the exertion of  
keeping the body horizontal and the labour  
in supporting the head, are all attended  
with great fatigue. —

Dr Franklin has concluded his little practical  
essay on swimming by saying it is  
"an art which when once acquired is never  
forgot," This is uttered with a kind of  
apologetic paint, that would seem to  
himself

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its truth with some triumph to this 50  
peculiar art. But there are many other  
arts that are never forgotten tho' learn'd with  
greater difficulty and in much longer time.  
The power of memory in any art depends on  
the number, complexity and rapidity of motion  
necessary for its execution. If the motions be  
numerous or complex, the power of the memory  
over many parts of the precept will be lost from  
the weight of the burden, if the art require ra-  
pid movements, the ability for them must be  
preserved by continual exercise - The art  
of playing on musical instruments, and some  
of the manufacturing arts which have been  
aptly term'd the arts of handling are often for-  
gotten in the particulars of their austere  
detail, since the vast number and manifold

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51  
sleight of motion they require is too  
great for the memory, But the more general  
and leading practices of these arts when once  
learn'd are retained for ever. - If swimming  
requires such intricate and almost infinite  
movements as musical performance, the skilful  
execution would like this after an intermission  
be forgotten. But if the theory of swimming  
given to you be correct, the memory is only re-  
quired to bear this simple precept, that the  
back must be elevated to the surface of  
the water. This may and surely will be re-  
tained for the longest life. and as the mo-  
tions for effecting this horizontal position are  
not necessarily rapid there is no need of  
constant practice to preserve dexterity. The  
art of swimming then is not forgotten only

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because there is little to be remembered. 52  
I have never heard that the art of Skating  
is forgotten and yet the unaccustomed mo-  
tions and management of the body for  
this exercise are more numerous than for  
swimming. As in it there is a necessity for  
a rigidity of muscles to preserve the position  
but there is besides a necessity to retain the re-  
collection of the variations of the centre of gra-  
vity, the most delicate perhaps of our bodily  
perceptions, yet when this art is once acq-  
uired the knowledge of it is indelibly brand-  
ed on the memory. —

I have thus gentlemen endeavored to exhibit to  
you some leading views of the Theory and art  
~~practice~~ of swimming. If I cannot call it an  
important subject for your consideration. I

Romans..

"Necit nec litteras nec natans."

at last believe it to be the most popular<sup>53</sup>  
~~and practical~~  
that could be selected from the whole corn-  
-pass of Physiology, since every man has some  
interest in it. The ancients, whose political  
institutions inculcated and required the prac-  
tice of Athletic arts, used to say in contemp-  
tuous reproach of the neglective education  
of any one that "he knew neither his letters  
nor how to Swim." The Campus Martius at  
Rome was chosen on the borders of the Tiber  
that the school and sports of the field and  
water might be united and relief afforded  
to the dust and fervor of their daily drill. Our  
times do not command the necessity of an  
education in this art, and tho' it may be ques-  
tioned whether the rare occasions which occur  
of preserving life by it, should make it an  
impossible part of instruction, more than

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many other arts of equal utility which 54  
are not universally taught - yet it becomes  
an object of interest and curiosity to all, <sup>from</sup> the at-  
tempts that are universally made either through  
usefulness or pleasure to acquire it.

It is a triumph of modern science which  
the ancients neither affected or gained, that  
the intellectual efforts of philosophers have been  
turned to those practical labours that benefit  
the moral the political and physical sta-  
-tion of man. The intellectual industry of  
antiquity was wasted in the vanity of its  
pursuit, and the adorning of its literature, its  
abstract sciences and elegant arts, must  
apologise the loss the world has sustained from  
the fruitfulness of much of its philosophical  
labour. We look with wonder on a  
people

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who could confuse its Religion with Mysti<sup>55</sup>  
scism, and deform its science by the enquiry  
after first and unsearchable causes, and at the  
same time with flagrant inconsistency rise  
to a confession of the want of Christianity, and  
approximate to the sublime inventions of Leibnitz  
and of Newton. -

This neglect of the highest aim of science its practical  
applications, was not the result of its necessary progress  
tho' the early steps of imbecility, since Archimedes e-  
qually skilled in theoretic and practical knowledge has  
left his opinion that the practical and mechanical  
views of science were beneath the mind, and that the-  
oretic and abstract pursuits were the godlike employment  
of man. And whilst he has given the posterity whole books  
on the properties of Curves he has made no mention of  
those wonderful arts by which he preserved his country  
from all the attacks of a skilful and powerful enemy.  
He paid a fatal tribute to his abstract partiality,  
a type to the world of the fatality that must

await the scientific pursuits of man in a  
universal reliance on this belief — — —

James Rush

Philadelphia

October 1815

